NOTES FROM PACIFIC COAST OBSERVATORIES

The Masses of Visual Binary Stars

In *Contributions from the Mount Wilson Solar Observatory* No. 142, Adams and Joy publish a list of parallaxes of 500 stars determined by Adams's spectroscopic method. Comparing their list with the list of orbits of visual binary stars printed in my book, *The Binary Stars*, I find 28 stars common to the two. As every addition to our knowledge of the masses of the binary systems is of the highest interest, I have examined these 28 systems to determine their value in this connection.

It is well known that when the distance, or parallax of a binary star has been determined as well as the elements of its orbit, the mass of the system, in terms of the Sun's mass, can be computed from Kepler's harmonic law put in the form,

$$(m + m_1) = \frac{a^3}{\pi^3 P^2},$$

in which π is the parallax of the system, P the period, a the semi-axis major of the orbit and the units of mass, length and time are, respectively, the Sun's mass, the astronomical unit and the year. Table IX (page 209) of my book gives the masses of 14 visual binaries computed by means of this formula. Two of these stars are *Sirius* and *Alpha Centauri;* the remaining 12 are also in the list of 28 mentioned above. According to the data of my table the masses of these 12 pairs range from 0.45☉* (Krueger 60) to 3.3☉ (ϵ *Hydrae*), and the mean mass of a system is 1.61☉. Using the parallaxes given by Adams and Joy for these 12 stars, I find the range to be from 0.21☉ (ϵ *Hydrae*) to 7.21 (ζ *Herculis*), and the mean mass of a system to be 1.67☉. While there are considerable discordances for individual systems, the agreement of the means is so close that we may regard the new parallaxes, in the average, as accurate for mass determinations as those derived by trigonometric methods. I have therefore used them to compute the masses of 7 additional systems for which the elements are known with sufficient exactness. The results are as follows:

Star	Magnitudes	Spectrum	Period (Years)	a	π	$(m + m_1)$
β 395	6.4–6.5	Ko	25.0	0.66	+0″.066	1.60 ☉
β 883	7.9–7.9	F5	16.61	0.19	0 .033	0.69
Σ 3121	7.6–7.9	Ko	34.0	0.67	0 .083	0.46
γ Virg.	3.6–3.7	F	182.3	3.74	0 .078	3.24
β Delph.	4.0–5.0	F5	26.79	0.48	0 .038	2.81
τ Cygni	3.8–8.0	Fo	47.0	0.91	0 .042	4.60
κ Pegasi	5.0–5.1	F5	11.35	0.29	0 .066	0.66
Mean mass, 7 systems						2.01 ☉

*Symbol for Sun.

Taking the masses of the seven stars in this table, the masses of the 12 systems mentioned above as deduced from the spectroscopic parallaxes and the masses of *Sirius* (3.3⊙) and of *Alpha Centauri* (2.0⊙), which are the best determined stellar mass values we possess, we have a total of 21 systems, with masses ranging from 0.21⊙ to 7.21⊙, the mean value being 1.88⊙. Some of the individual mass values must still be regarded as quite uncertain, but the mean result may be taken as strong confirmatory evidence that, in the average, the visual binary systems, at least the short-period systems relatively near to us, are about twice as massive as our Sun.

The number of systems is hardly large enough to permit safe deductions as to possible correlations between mass and spectral class or between mass and absolute magnitude; but it is of interest to note that the five stars of classes K and M are, on the average, only half as massive as the 16 stars of classes A to G, and are, on the average, nearly four magnitudes (absolute) fainter.

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AN INTERESTING VISUAL BINARY SYSTEM

In 1892, Hough found a 13th magnitude companion to the 6.7 magnitude star B. D. +26°, 1865 (R. A. $8^h 49^m 00^s$; Decl. +26° 36′; spectrum G0); in 1910, I discovered the bright star itself to be a close unequal pair (A 2131), and my measures of Hough's companion (Ho 357) showed a very decided increase in the distance with slow change in the angle in the interval of eighteen years.

I have just repeated the measures of these stars and give here my two sets of measures together with those of Hough for the wide pair.

Ho 357

1892.29	8°.2	31″.06	2n	18½-inch	Hough
1910.13	4 .2	38 .79	2n	36-inch	Aitken
1919.19	3 .2	42 .76	2n	36-inch	Aitken

A 2131 = Ho 357 AB

1910.15	254°.6	0″.32	3n	36-inch	Aitken
1918.00	298 .8	0 .30	1n	36-inch	Aitken
1919.19	299 .4	0 .32	2n	36-inch	Aitken

The three measures of Hough's companion fall quite precisely upon a line in position angle 169°.5 and indicate a proper motion of the bright star in that direction amounting to 0″.445 per year.